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INSECTS AND DISEASES INJURIOUS TO CRANBERRIES.

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INSECTS AND DISEASES INJURIOUS TO THE CRANBERRY.

E. S. GOFF.

By request of the Wisconsin State Cranberry Association, this bulletin has been compiled to furnish information relating to certain insects and diseases injurious to the cranberry, especially those that are most destructive in Wisconsin. For our information we have drawn very largely upon two bulletins of the New Jersey experiment station,* as no systematic study of cranberry insects and diseases has as yet been made in our State.

Some confusion appears to prevail among our cranberry growers regarding the names and the distinctness of some of their common injurious insects. Thus the "tip worm" is regarded by some as being only the first brood of the "vine worm." Others consider the "vine worm" and the "fire worm" as two distinct species. This confusion of nomenclature renders it especially important that specific information upon these points be furnished. Prof. Smith, from whom the data upon insects given in this bulletin are chiefly drawn, has devoted a large amount of study to cranberry insects both in New Jersey and Massachusetts, and his authority upon these subjects need not be questioned. The description of species, with all notes of life history used in this bulletin are copied almost verbatim from his bulletin above cited.

Correspondence from the cranberry growers of our state, relating to injurious insects or diseases is invited. Should injurious insects or diseases appear that are not treated in this bulletin, if suitable specimens are sent to our Station, the effort will be made to identify the same, and to suggest preventives or remedies for them. Additional information relating to the insects or diseases here treated will also be gladly received.

It should be remembered that the dates given for the appearance and changes of the insects here treated are recorded for New Jersey, and not for Wisconsin. Some allowance may be necessary in using these notes of life history in our state on this account.

THE BLACK-HEADED CRANBERRY WORM.

Rhopobota vacciniana, Pack.

"This is the 'vine worm' of Massachusetts, and the 'fire worm' of New Jersey." It does not appear to be a serious enemy to the cranberry in Wisconsin, but is quite destructive in New Jersey. "In its perfect or imiginal state it is a small moth, the wings expanding nearly half an inch, the upper pair long and narrow, the lower broad and rounded outwardly. In color, the fore wings are a sordid, brownish gray, with alternate pale and darker shade bands, arranged as shown in figure 1. The hind wings are of a rather uniform smoky brown.

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*Special Bulletin K. issued Feb. 28, 1890, "The Insects Injuriously Affecting Cranberries," by Prof. John B. Smith; and Bulletin No. 64, issued Dec. 3 1890, "Some Fungus Diseases of the Cranberry," by Dr. Byron D. Halsted

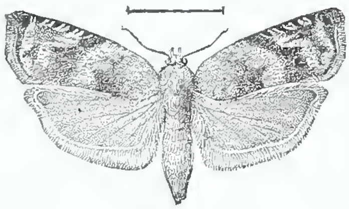

Fig. 1.—Enlarged figure of moth of black-headed cranberry worm. (After Riley). The line at the top indicates the natural size.

"These moths appear on the bogs (in New Jersey) twice in each year, the first time early in June, continuing more or less abundantly throughout the month, and again about the middle of July, continuing to about the middle of August. The latter of these broods is often present in excessive numbers, and the eggs deposited in late July and early August remain on the vines during the winter and hatch the following spring.

"The eggs are minute yellow discs of the general form and shape of 'fly specks,' deposited on the under side of the leaves, often in very large numbers. I have found as many as fourteen on a single leaf. Where the moths have been plentiful, scarcely an 'upright' but had at least one egg. (An enlarged leaf showing three eggs is shown in Fig. 2.)

"The date at which these eggs hatch in spring varies according to the temperature and the date at which the water is drawn. * * * It may be generally stated that where, in an ordinary season, the water is drawn before the middle of May, the larvæ will appear about a week after. They generally appear just about the time, or even before the vines start to grow, eat for a little time of the old foliage and then web up the terminal leaves, somewhat in the manner shown in figure 3."

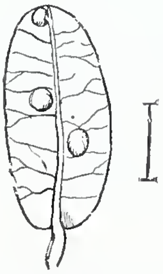

Fig. 2.—Enlarged leaf, showing eggs.—Smith.

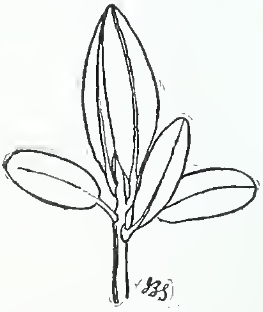

Fig. 3.—Terminal leaves webbed together by larva, enlarged.—Smith.

At this stage the larva is a small, narrow, velvety, green caterpillar with a prominent, shining black head and neck, very active, and readily disturbed when an effort is made to investigate its habitation. The feeding is done entirely between the webbed leaves, and in the first brood the larvæ often come to maturity in the habitation first spun up. "More usually, however, when they attack a shoot just started, they soon check its growth by eating into the tip—in fact they sometimes eat the bud before it has started—and then they make their way to another vine, still webbing up only the terminal leaves, giving an appearance shown in figures 4 and 5.

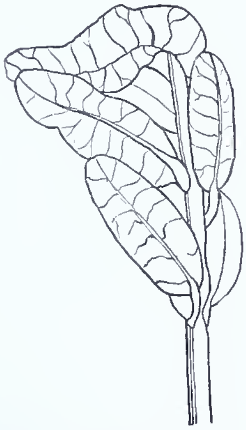

Fig. 4.—"Upright" with terminal leaves webbed together by larva. (Enlarged). -Smith.

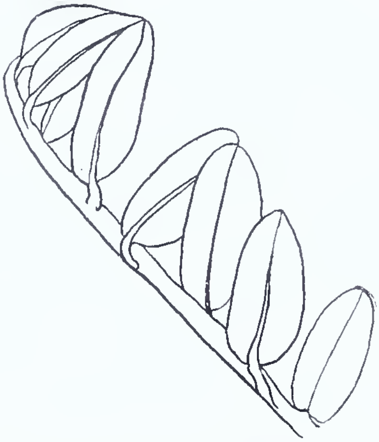

Fig. 5 —" Runner" with terminal leaves webbed together by larva. (Enlarged).—Smith

"When fully grown, the larva is from three-eighths to one-half an inch in length, of the same velvety, green appearance, and with the same black head and neck so prominent in the young specimens. It is, however, stouter in appearance, and, when closely examined, is seen to be transversely wrinkled, and set with rather long, fine hair. Each of these hairs arises from a little shining disc, of which there are four at the top of most of the segments, and one at each side. The discs at the middle have two divergent hairs. Figure 6, *a* is an enlarged copy of the larva, showing its appearance as seen from above.

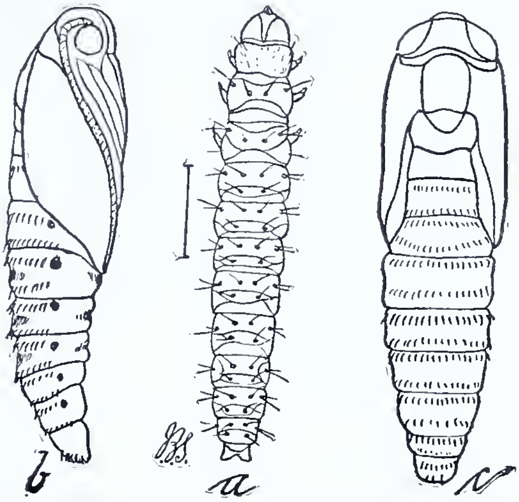

Fig. 6.—Larva and pupa of black headed cranberry worm—much enlarged. *a*, larva; *b*, pupa from side; *c*, pupa from back. The vertical line indicates the natural length of the larva.—Smith.

'When ready for the change to the pupa state, the larva lines the interior of its house with silk, and in this tube changes to a stubby little yellowish-brown pupa, a view of which from the side and back is given at *b* and *c*, figure 6. It will be noted that the wings, feelers and other body parts are outlined in this pupa. It has two series of little spinules on the abdominal segments, and a series of little hooks at the blunt tip. In feeding, the larva does not eat the entire substance of the leaf, but nibbles off the upper side only, except, of course, when it attacks buds, and then the whole leaf is destroyed.

"The change to the pupa state takes place some time early in June, and the moths appear about the middle or toward the end of this month. The dates vary according to the time at which their growth started, but the moths appear generally in twenty to twenty-five days after the hatching of the larvæ.

"The moths are usually inactive during the day, but start up when disturbed, only to alight again among the vines a short distance off. During the early evening, however, they are more active and fly readily, hovering in the air very much after the manner of a mosquito, though not far above the vines. At this time they pair and, probably, deposit their eggs. The life of the moth does not exceed ten days to two weeks, but as the date of hatching varies, the moths may abound more or less abundantly for a month. Usually they are gone early in July.

"About the end of June or very early in July, the larvæ of the second brood begin to hatch, and now begins the serious damage." At this time

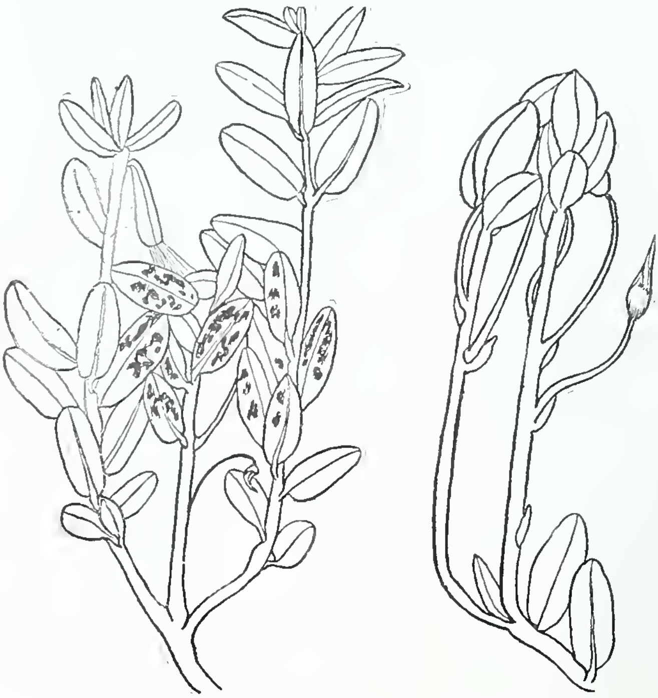

Fig. 7. Fig. 8.

Showing work of second brood of larvæ. (Enlarged).—SMITH.

the vines are nearly or quite ready to bloom, and foliage is abundant. Unlike the first brood, the larvæ of the second brood are not content to spin up a single tip, but gather into their web everything within their reach. Two and sometimes three sprays, with all their buds, are often included, and every chance for fruit is destroyed. The buds, flowers and young berries are favorites with these gluttons, and in a very few days the prospective crop is ruined. Instead of eating a leaf entire, they take a few bites here and there, and in a little while the bog presents the appearance of having been burnt over, which first induced the application of the name "fire worm." Three days often suffice to change a bog from green to brown—a blow to the grower's prospects of fruit for that year. The larvæ develop rapidly, and are ready to pupate by or before July 10, except where late drawing of water delayed them. In the latter case the vines are as late as the larvæ, and the latter still appear at the corresponding stage of development of the fruit. Figures 7 and 8 show the work of the second brood.

After the middle of July, the moths appear in swarms and deposit eggs for the next year's brood. The vines soon begin to recover from the damage done by the larvæ, and by the middle of August little trace of their work remains. The leaves look beautifully green and flourishing, but—there is no fruit.

Preventive measures will be considered after the description of the next insect, as the two need largely identical treatment.

THE YELLOW-HEADED CRANBERRY WORM.

Teras vacciniivorana, Pack.

The moth producing this larva expands from one-half to five-eighths of an inch, and is, during the summer, of a uniform orange color, while the fall brood is of a uniform slate gray, with a more or less evident admixture of reddish brown scales. Figure 9 shows the form of the moth. The uniform color, larger size and broader wings easily distinguish it from the moth of the black-headed species.

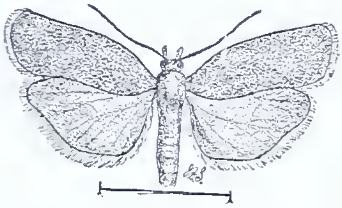

Fig. 9.—Moth of yellow-headed cranberry worm. (Enlarged).—Smith. The horizontal line indicates the natural size.

This moth lives through the winter among rubbish, in crevices, under bark, in the cranberry house, or wherever a suitable shelter can be found. It is the slate gray form which hibernates, and in the latter part of April, or the first of May, the moths become active and seek a place to deposit their eggs—on cranberry when obtainable, otherwise on the huckleberry or apple.

Except for their slightly larger size, the eggs of this species are indistinguishable from those of the black-headed cranberry worm. They hatch very soon after they are laid, into a rather stumpy little caterpillar of a yellowish-green color, and with a yellow head and neck. It has the same habit of webbing up leaves as its black headed ally, and with an even chance, the species grow well together. In a patch infested by both species, no difference appears in their webbed habitations. As the larva grows it continues to share the bad habits of its neighbor, attaining full size late in May or early in June. It is then about half an inch long, rather stout, and very similar in its transverse wrinkles and polished disc-like spots to the black-headed larva. The differences are, however, perceptible by comparing figures 6*a* and 10*a*. When fully grown the larva spins a silken tube, in which it changes to a blackish pupa, readily distinguished by the little knob on the head. A side and back view are shown in figure 10, *b* and *c*.

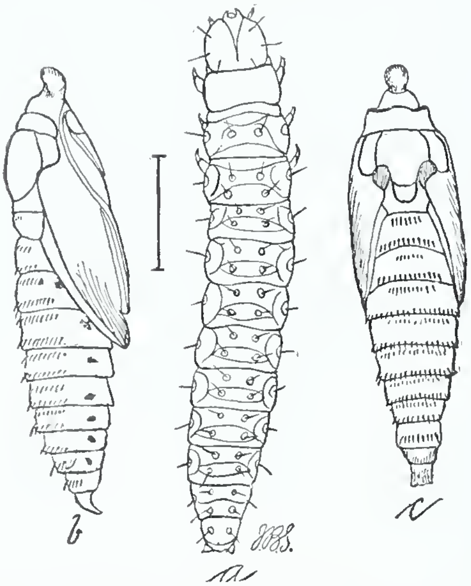

Fig. 10.—Larva and pupa of yellow-headed cranberry worm, much enlarged. *a*, larva; *b*, pupa from side; *c*, pupa from back.—SMITH.

In about a week the moth appears. It is orange-yellow in color, though its parent was slate gray. The moths deposit their eggs from the beginning until after the middle of June. These hatch from the 20th to the 25th of the month, and by the time the vines are in blossom, the larvæ are half grown and capable of almost unlimited destruction. They are worse than those of the other species, because they make larger webs and are especially fond of young berries. Becoming full grown about the middle of July, they change to pupæ, and late in July or early in August the moths, again orange-colored, are on the wing. The eggs of this brood hatch late in August or early in September, and the larvæ now grow very slowly and very irregularly, not becoming full grown until October, about the middle of which the now slate-colored moths appear, ready to pass the winter. This third brood injures the cranberry crop less than the second, as the larvæ do not begin their work until the berries are considerably grown.

"Another peculiarity about this third brood of larvæ is their tendency to a reddish color, which is marked in a large proportion of the specimens, and in the latest of all assumes the form of distinct stripes. On October 19, I found plenty of moths, numerous pupæ and a few larvæ of the distinctly red-striped form, agreeing perfectly with Dr. Packard's descriptions. These I succeeded in bringing to maturity, and each of them proved, on attaining the imago state, to be a fine specimen of the present species. Careful examination showed that, except in the red stripes, the larva did not differ from the ordinary even-colored form, and the pupa, when formed, was identically like that of the other. It results, therefore, that the 'Red-striped Cranberry Worm' of Packard is only a late form of *vacciniana*, and does not refer to any other or distinct species."

The damage wrought by the yellow-headed cranberry worm in New Jersey on bogs where no efforts are made to combat it is often very great. It is probably the most destructive insect enemy to the cranberry in Wisconsin, and appears to be confused by many with the black-headed species.

PREVENTIVE MEASURES.

Late Holding of Water.—Fortunately, we have an easy and complete preventive for the attacks of the yellow-headed cranberry worm. As the eggs are laid early in spring, a bog completely covered with water up to the 12th of May will escape. To make the exemption complete, however, all vines out of the water should be uprooted, as the moths will oviposit on these and the second and third broods may invade the bogs and do considerable damage by preventing the setting of fruit buds. The banks of the bog should be kept entirely free from vines, and no part of the bog should be left uncovered.

The black-headed cranberry worm is less easy to deal with, as the eggs being laid in summer remain on the leaves during the winter and hatch in spring as soon as the temperature becomes sufficiently warm. However, Prof. Smith cites the testimony of several New Jersey cranberry growers who have found late holding of the water (until May 15 to 28) a satisfactory preventive of injury from the black-headed species. In isolated bogs which are not much invaded with insects from the outside, late holding one spring has sometimes proved effectual for two or three years. Retaining the water up to the middle of May, has not, however, always proved successful in New Jersey.

REFLOWING.

Wherever circumstances allow, reflowing is found in New Jersey, to be the best preventive for the black-headed species. By this is meant drawing off the water the latter part of April or the first part of May, leaving the bog uncovered until the eggs have all hatched and covering it with water again about the middle of May for 24 to 36 hours. This will not hurt the vines and will destroy all larvæ upon them. Reflowing is said to further benefit the vines by giving them an early start, which hastens somewhat the ripening of the fruit. Mr. H. O. Kruschke, of Wisconsin, thinks that flowing for this insect can avail nothing in this state, owing to the prevalence of vines outside of the flowed marshes.

THE KEROSENE EMULSION.

Experiments in New Jersey have shown that an emulsion of kerosene destroys not only the larvae but the eggs of both the black-headed and yellow-headed cranberry worms. Prof. Smith advises the spraying of all bogs on which the late holding of water or reflowing is impracticable, with this material early in the season, before the eggs have had time to hatch.

The kerosene emulsion has been used to a slight extent in Wisconsin, and so far as tried has proved successful.

To make this emulsion, dissolve one pound of any good hard soap in two gallons of boiling water. Then remove from the fire and add immediately two quarts of kerosene. Pour the mixture at once into a large can and shake vigorously for half a minute, or pump it rapidly through a force pump. This will cause an intimate combination of the kerosene and soapsuds that will not readily separate. Before using add two gallons of water to every gallon of the emulsion. If the emulsion has become cold, dilute with hot water.

The emulsion is best applied with a force pump with a nozzle that produces a fine spray, and care should be taken to wet the under side of the leaves.

If the use of the kerosene emulsion has been neglected until the larvæ begin to hatch, the vines should be sprayed at once with water containing Paris green at the rate of one pound to 150 gallons. It is very important that this treatment be given before the larvæ have webbed the leaves together. If this second opportunity should be missed, the kerosene emulsion applied to the webbed leaves will still destroy many of the larvæ.

A decoction of tobacco is much used for destroying the larvæ of these insects in the Cape Cod cranberry district with eminent success. About one and one-half pounds of low grade tobacco or tobacco stems are soaked for a few hours in a gallon of water, and the decoction thus formed is sprinkled upon a square rod of the vines.

In case, from any cause, the first brood survives, a close watch should be kept for the second brood, and at the first signs of hatching, an application of Paris green and water of the strength above noted should be made, unless the plants are in blossom. In the latter case, the flowers might be injured by the poison, and bees and other insects visiting them might be poisoned.

The necessity of applying the poison before the larvæ hatch is even greater for the second brood than for the first, because it webs up the leaves more than the latter, and thus greatly increases the difficulties of reaching the insects.

THE CRANBERRY FRUIT WORM.

Acrobasis Vaccinni, Riley.

This is one of the most serious insect enemies of the cranberry in Wisconsin. The other injurious insects are chiefly local in their attacks, while this one is almost everywhere present, and sometimes destroys a large percentage of the crop.

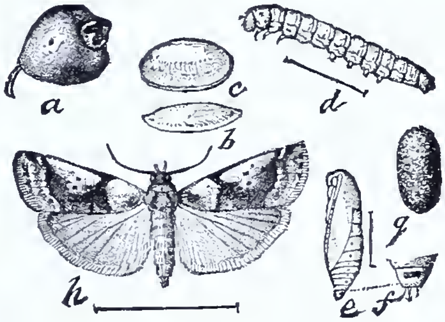

Fig. 11.—Cranberry fruit worm. *a*, berry, showing egg; *b*, egg from side; *c*, egg from top; *d*, larva; *e*, pupa; *f*, tip of pupa; *g*, cocoon; *h*, perfect insect. All enlarged.—Riley.

This insect is well shown in figure 11. In its general colors the moth is ash-gray mottled with white, the darkest part of the gray shading nearly to black. It appears on the bogs at the time the berries are beginning to set. It is a shy insect, flies with a darting motion, sometimes for quite a long distance, and is not generally recognized by the grower, even when the berry worm is abundant on his bogs. When at rest, the wings are folded close to the body, and on the cranberry stem the moth is not easily recognized, except by an experienced eye. The eggs are laid on the young berry, usually in the calyx, just beneath one of the trigonate lobes. These are flat or slightly convex, round in outline and pale yellow in color. The egg hatches in July or early August, about five or six days after it is laid, and for a day or two the young larva feeds in the calyx, after which it makes its way into the berry, eats out the seed chamber, and then migrates to another fruit. The vacated berry turns red and finally shrivels and drops. The larva, on entering the new fruit, closes the entrance with a dense web of fine white silk, so that it is sometimes difficult to see where the hole was made. In this berry it becomes half grown, and, working out, leaves a jagged opening and again enters a new fruit. The berries are by this time well grown, and sometimes the larva reaches its full growth here. The entrance is as carefully closed as in the preceding case. Soon the affected berry begins to show a red color, denoting to the practised eye the presence of the enemy, but to the casual observer appearing only to be nicely ripening. Where the larva does not complete its growth in this fruit it migrates to another, this time not closing the hole behind it. Sometimes two or three berries are fastened together by the larva, each being hollowed out in succession. Fig. 12 shows the work of this insect.

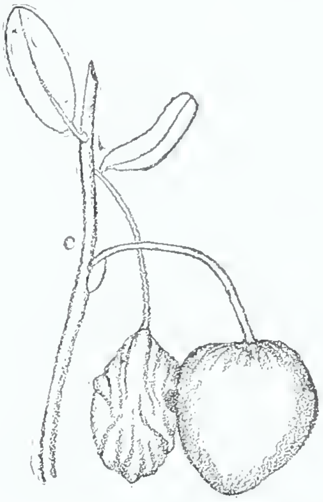

Fig. 12.—Work of cranberry fruit worm, showing shrivelled berry fastened to a sound one newly attacked.—SMITH.

The larva comes to maturity during September, not always being fully grown at picking time. It is then rather more than half an inch long, bright green in color, usually with a reddish tinge on the back. The head is narrower than the first segment, and of a paler, more yellowish color, except the mouth, which is brown. The transversely wrinkled segments are clothed with a few rather long hairs. As a whole, the insect is more stout than either of the preceding. When full grown the larva leaves the berry, and, in the soil at the roots, forms a dense cocoon of silk, in which it changes to a brown pupa. In this state it passes the winter, the moth issuing the following July.

This insect is not very destructive in New Jersey, but on Cape Cod it is most injurious, sometimes destroying ninety per cent. of the crop.

Preventive Measures.—Flowing to destroy the cranberry fruit worm is out of the question, unless the crop be sacrificed. In a very badly infested bog it might be wise to do this, and thus be rid of the pest for a few years. The life history indicates only a single possibility of combating it, and that is at the time of hatching of the larva and before it enters the berry. As with the codling moth, the effort must be in the direction of applying poison so that the larva will find it when it begins to eat. The eggs of both are usually laid in the calyx, where the larva hatches and feeds for a day or two. The codling moth is controlled in this way, and as the cranberry fruit worm offers an almost identical case, the same preventive may be equally successful.

When the berry worm becomes so abundant as to cause much injury Prof. Smith advises a thorough application of Paris green, at the rate of one pound to two hundred gallons of water, as soon as the berries are set. The calyx will afford a lodgment for the poison, which will not be readily washed out. In badly infested bogs, a second spraying a week later would be advisable.

Mr. H. O. Kruschke, of Wisconsin, thinks the use of a lamp, set over a pan of water placed upon the marsh, proves beneficial in destroying many moths of the fruit worm.

THE TIP WORM.

Cecidomyia Vaccinii, Smith.

This insect is treated at some length by Prof. Smith in the New Jersey bulletin already referred to, and its life history has been in part worked out by him. The damage caused by it in New Jersey appears to be very slight, and I am not sure that it is present at all in Wisconsin, though the name "tip worm" is often used with reference to one or more insects in our cranberry marshes. In order to clear up the apparent confusion in relation to this insect, an illustration and description of the true tip worm are presented, with drawings from Prof. Smith showing the manner in which it works its injury.

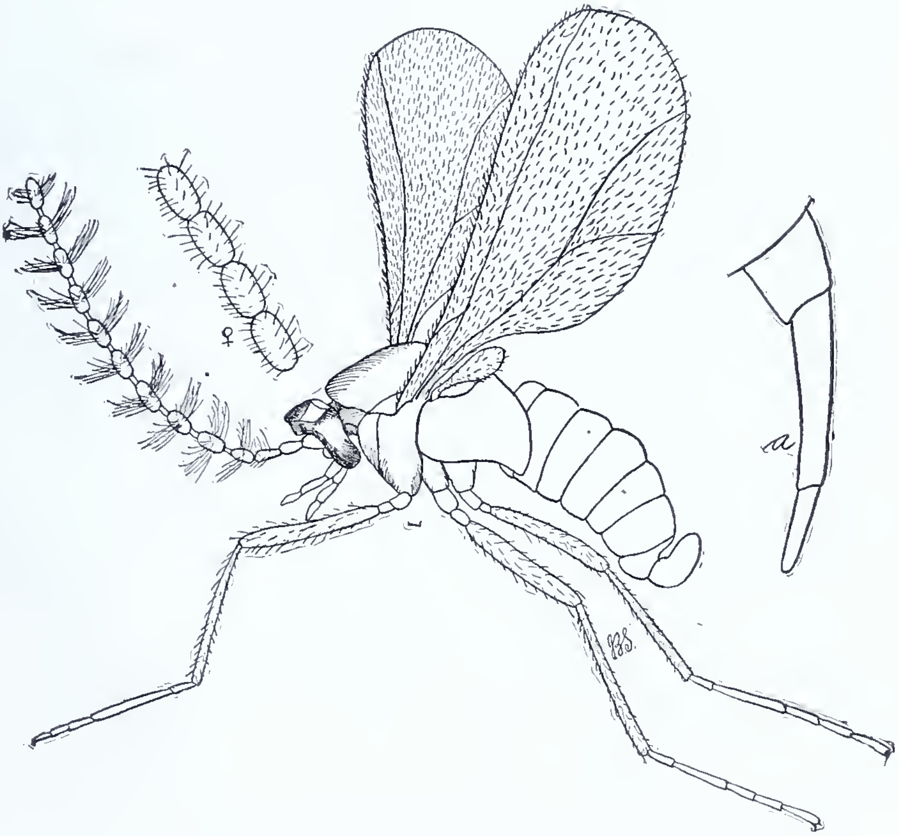

Fig. 13.—The true tip worm (male), greatly enlarged. *A*, ovipositor of female. Antennal structure of female shown at left.—Smith.

"This insect, in the imago (perfect) state, is a minute two-winged fly about one-sixteenth of an inch in length of body, the wings expanding about an eighth of an inch, and covered with fine hair. In color, the female is recognizable at once by the deep-red abdomen, the grayish upper side of the thorax, the sides more yellow, and the black head and eyes. The male is smaller than the female, of a more uniform yellowish-gray, and also with black eyes. The legs are very long and yellowish and covered with fine hair. The antennæ of the male are long and very handsome, appearing like a string of beads, each bead set with long hair in a circle around it. The antennæ of the female are much shorter, with the joints oval and closely joined.

The female is furnished with a long, extensile ovipositor, by means of which she thrusts her eggs into the very heart of the young shoot, probably depositing them at the base of one of the minute leaves just forming. Figure 13 is a magnified view of the mature insect. The larva is a minute orange-red or yellow grub. It has no legs, but wriggles about quite lively when disturbed. It works its injury rather by scraping the epidermis and sucking the juices than by any direct eating of the plant. Only the most tender and juicy leaves are suitable for this insect, which may account for the absence of injury late in the season.

The first sign of the presence of this insect in a bog is that some of the terminal buds become very prominent, and the growth of the leaves seems to have ceased. There is apparently a pointed, oval bud which does not develop. When this is opened the little larva will be found inside of the extreme tip, at the base of the leaves, where a little, brown, eroded space shows the work of the larva. The tip usually, but by no means alalways, dies and presents the appearance shown at Figure 14 *a*. The larvæ are found in much larger numbers on the loosestrife (Lysimachia).

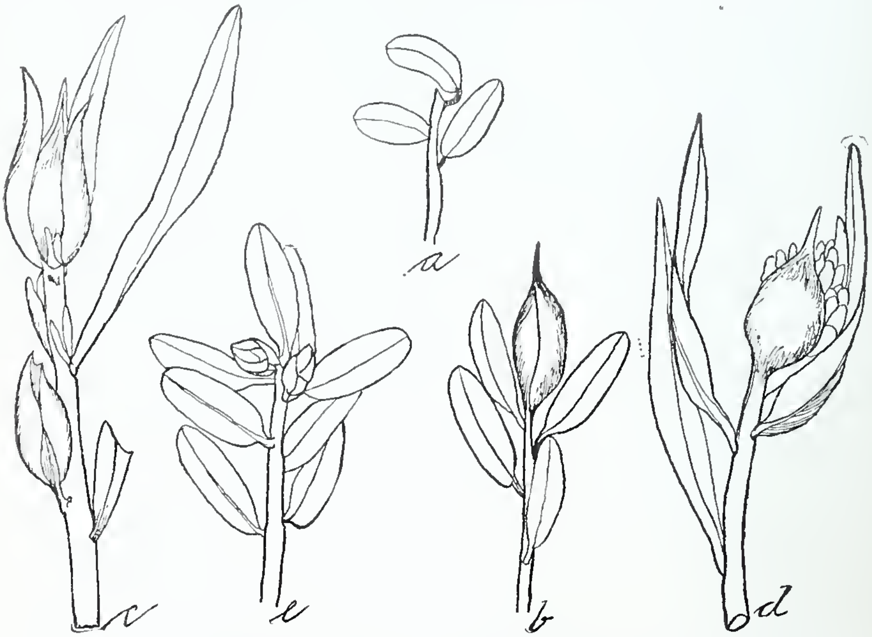

Fig. 14.—Work of the tip worm. *A*, cranberry shoot with terminal bud destroyed; *b*, shoot showing infested tip: *c*, loosestrife infested; *d*, same with damaged flower buds expanding; *e*, shoot forming fruit buds after the terminal bud is destroyed.—SMITH.

The only preventive regarded as at all practicable by Prof. Smith is the kerosene emulsion. In order to render this effective the loosestrife should be thoroughly cleaned out from the vicinity of the bog.

THE CRANBERRY SCALE.

Aspidiotus, Sp.

A scale insect was discovered by Prof. Smith upon a single New Jersey bog, in which it appeared to do considerable damage. I do not know that it exists in Wisconsin.. In order to enable growers to recognize it, should it be discovered, an illustration of a leaf infested with it and one of the scales largely magnified is shown in Figure 15.

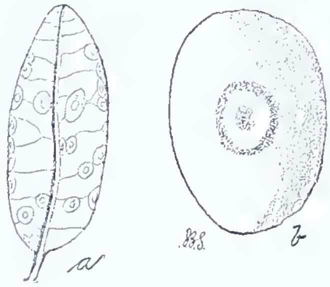

Fig. 15.—Cranberry scale. *A*, leaf infested with scales; *b*, a single scale greatly enlarged.—SMITH.

Should this insect appear in our state, a thorough spraying with the kerosene emulsion at the outset would probably eradicate it. (Since the above was written, Mr. H. O. Kruschke informs me that he has observed what he believes to be the cranberry scale in the neighborhood of Berlin.)

OTHER INJURIOUS INSECTS.

Besides the insects already mentioned, several species of grasshoppers and locusts are mentioned by Prof. Smith as proving more or less harmful to the cranberry bogs of New Jersey. Turkeys are suggested as the means most likely to prevent injury from these pests. Three specimens of leaf hoppers are also named, but they are believed to do little if any harm.

"The Cranberry Span Worm," which has proved destructive in Massachusetts, has not appeared in New Jersey. Mr. J. H. Treat informs me that if it occurs in Wisconsin it has thus far attacked only wild marshes.

DISEASES OF THE CRANBERRY.

In bulletin No. 64, of the New Jersey Experiment Station, Dr. Byron D. Halsted mentions two fungus diseases of the cranberry, giving at considerable length the results of his investigation into their life history. Mr. Treat is of the opinion that neither of these diseases has yet appeared in Wisconsin. If this opinion is correct, the only occasion for alluding to them at all in this bulletin is to remind our cranberry growers that these diseases are liable to appear in our state at some future time, and to furnish information that will permit the prompt recognition of them in case they should appear.

THE CRANBERRY GALL FUNGUS.

The first disease described by Dr. Halsted is that caused by the Cranberry Gall fungus. One of the symptoms of this malady is a red appearance of the plants attacked. The whole cranberry plant tends to develop a red color, and on close examination, small galls or protuberances will be found upon the leaves and young stems, and even upon the flowers and fruit. The galls vary in shape according to the character of the part affected, but in general are cup-shaped when fully grown, and from a twenty-fifth to a thirty-sixth of an inch in length and thickness. The galls themselves are of a deep wine color, or of the color of a ripe cranberry, and the infested part becomes misshapen and of a red appearance. They appear upon the plants in New Jersey about the first of May, and several other plants related to the cranberry are also attacked by the same disease.

The disease has proved very destructive in the bog where it was discovered, and appears to be spread by the water of the bog. The remedy suggested by Dr. Halsted is to withhold the water from the infested bog during the winter, or to burn all infested plants.

THE CRANBERRY SCALD.

This disease proves very destructive in New Jersey, less so in New England and it appears almost unknown in the west.

Dr. Halsted has shown that it is due to a specific fungus that is found in all parts of the infested plants and also in the surrounding soil. The manner in which the disease affects the plant is described by Dr. Halsted as follows: "The diseased fruit exhibits a soft spot upon one side, which may be quite small at first, but will usually extend throughout the berry, when it looks and feels not unlike one that has been partly cooked, but without the skin being broken. Sometimes there are several scald spots upon the same berry, which in time extend until the whole fruit is soft and light brown in appearance. While the scald spot is still small, the skin upon its surface is tense, and below it the substance is very watery, and almost colorless or carnelian. After a time, it may be weeks, the berry loses its plumpness and becomes a shriveled mass, with the tough skin yet unbroken and disposed in irregular ridges and folds. Many of the scalded berries become detached from the plant before the collapsed condition is reached but it is not unusual to find the shrunken fruit upon the vines late in the season, especially in severely attacked areas that were not gone over by the pickers. It is not uncommon for the berry to remain half rotten, and frequently the line will be perfectly distinct between the healthy and dis-

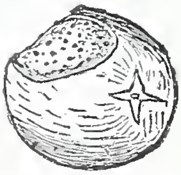

Fig. 16.—Cranberry partly scalded.—HALSTED.

eased portions. In such cases the juice of the scalded portion disappears, perhaps being absorbed by the healthy, plump tissue, and the diseased part becomes dry and dried down, even making a concavity in the berry, as shown in Figure 16. Soon after the berry is thoroughly scalded, it frequently exhibits a dark cloudiness below the skin, which increasing, extends as threads throughout the watery mass. After a time patches form just beneath the skin, and later on there may be seen small pustules upon the surface of the skin. The same development is observed upon the collapsed surface of the skin of those half-scalded berries above mentioned."

"Upon the bog visited there were patches of several square rods where the berries were scarce, all of them scalded and the vines had made but little growth. There was, in short, a half dead appearance to the vines, and many of the leaves had fallen off, while others were brown and quickly fell away upon touching the vines. A closer inspection showed that many of these dead leaves (Figure 17) bore small dark pustules upon their surface, in general appearance closely resembling those already found upon the fruit. The microscope revealed no difference greater than would be due to widely differing conditions between a soft, rich pulp and a firm skin for the berry and a comparatively dense, dry tissue for the leaf Throughout the central portion of the leaf the filaments of the fungus branched in all directions and corresponded to those found upon the inner surface of the berry skin."

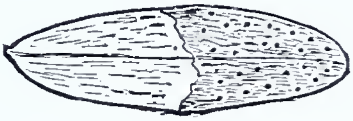

Fig. 17.—Cranberry leaf half scalded.—HALSTED.

No remedy is known for this disease.

SPRAYING APPARATUS.

As spraying is recommended for several of the insects named in this bulletin, some information in regard to spraying apparatus seems called for. A force pump capable of delivering a constant stream at considerable pressure, and fitted with a nozzle that produces a fine spray accomplishes the desired object, and pumps especially designed for this work are now offered by several of our leading pump makers of whom a list is appended at the end of this bulletin. We do not pronounce upon the comparative merits of the machines offered by these firms, but simply express the opinion that the spraying pumps sold by all of them will accomplish the work for which they were designed.

The accompanying illustration (Figure 18) may prove helpful to the inexperienced in fitting up a convenient spraying apparatus. The pump, which is of the tripod form, and the barrel for holding the liquid are carried upon a stone boat. The barrel has a large opening for receiving the liquid, over which a strainer, consisting of two or three thicknesses of cheese cloth is placed, and the strainer is arranged so that it can be readily

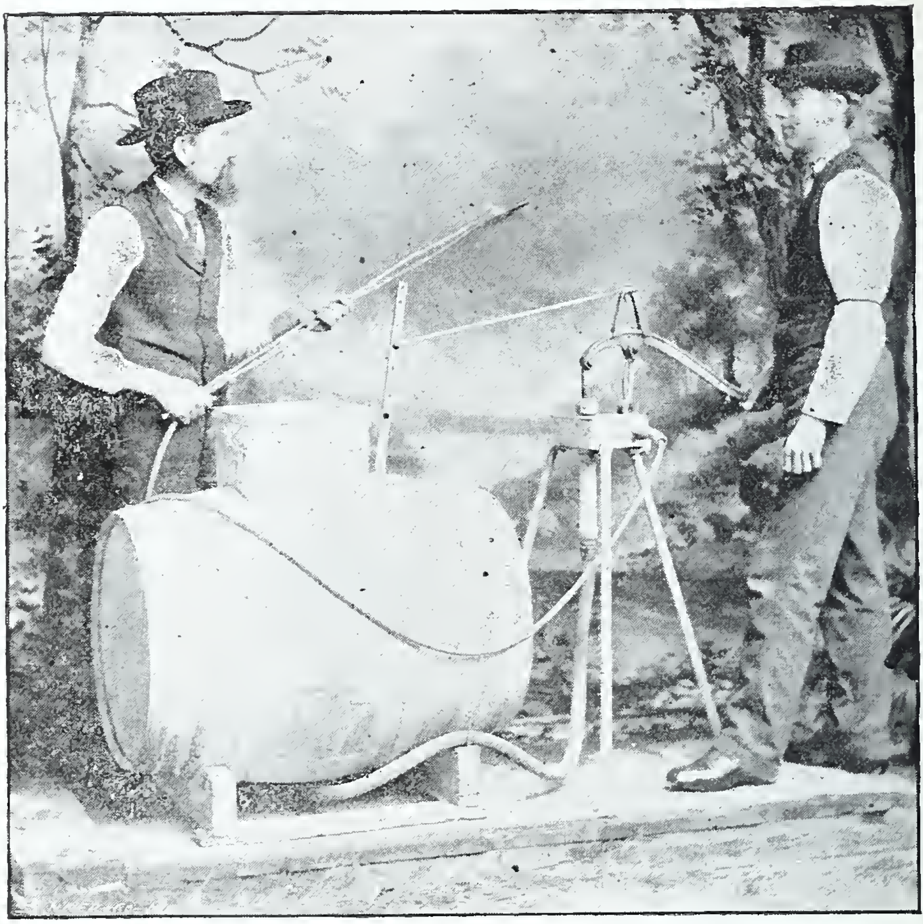

Fig. 18.—Convenient spraying apparatus.

taken off for cleaning. The suction tube is attached at the bottom of the barrel which makes it possible to draw off all the liquid with the pump. By means of a simple devise attached to the pump handle, and which is shown in the illustration, an agitator is operated within the barrel which insures an even distribution of the poison through the liquid. The hose, for distributing the spray, is of extra strong one-fourth inch rubber tubing, and is attached to a light reed fish pole. This tube is sufficiently large to supply the nozzle, while it and the pole are so light that they may easily be held out at arm's length when necessary. A short section of heavy rubber tubing slipped over the smaller tube at its union with the pump, greatly protects the smaller tube from breakage at this point.

A pump fitted up like the one here described will cost, exclusive of the stone boat, about fifteen dollars, of which the pump, nozzle and hose will represent about twelve dollars. Any desired length of hose may be used, but if this is more than twelve feet long, the cost will be something more than above stated.

The Nixon Nozzle and Machine Company manufacture a pump that sprays kerosene and water directly, obviating the necessity of making the kerosene emulsion.

Acknowledgements are due to Hon. J. A. Gaynor, of Grand Rapids, Wis.; Mr. J. H. Treat, of Meadow Valley, Wis., and Mr. H. O. Kruschke, of Deuster, Wis., for information and assistance in preparing this bulletin.

A LIST OF THE PRINCIPAL MANUFACTURERS OF SPRAYING PUMPS.

Field Force Pump Co., Lockport, N. Y.
Gould Manfactuuring Co., Seneca Falls, N. Y.
Rumsey & Co., Seneca Falls, N. Y.
Nixon Nozzle & Machine Co., Dayton, O.
Wm. Boekel & Co., 518 Vine street, Philadelphia, Pa.
Wm. Stahl, Quincy, Ill.
The Deming Co., Salem, O.
F. E. Meyers & Bro., Ashland, O.
W. & B. Douglas, Middletown, Conn.